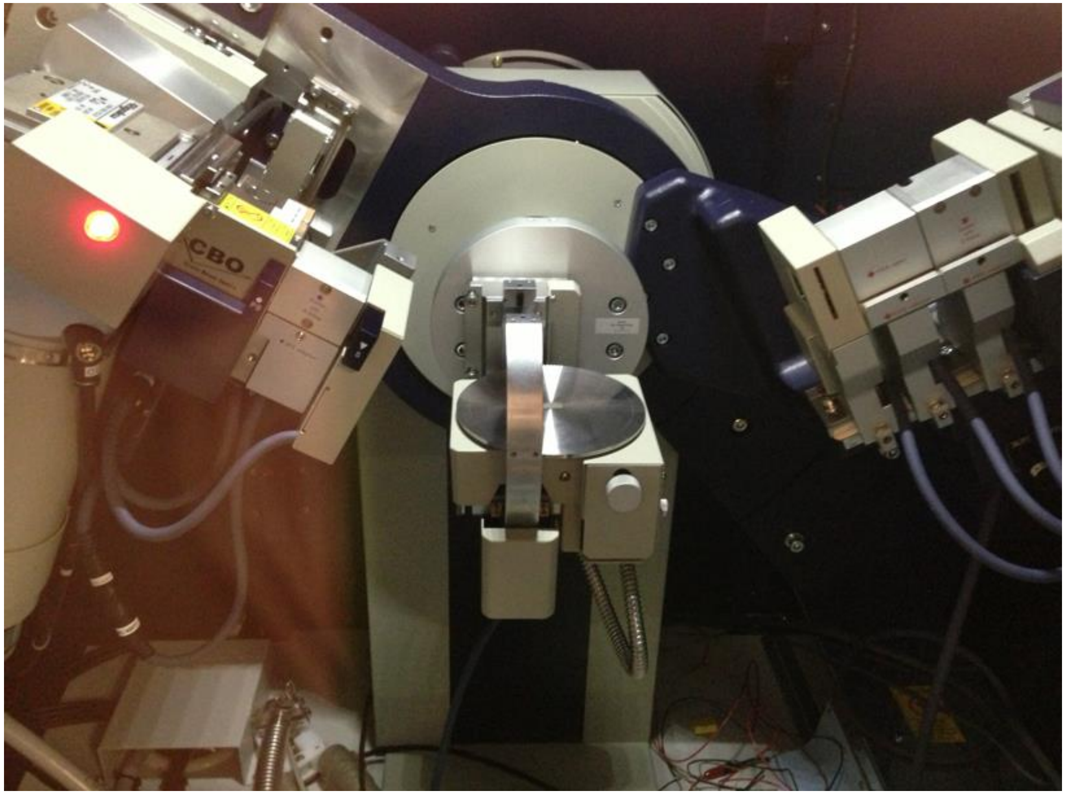
Our new Rigaku SmartLab XRD

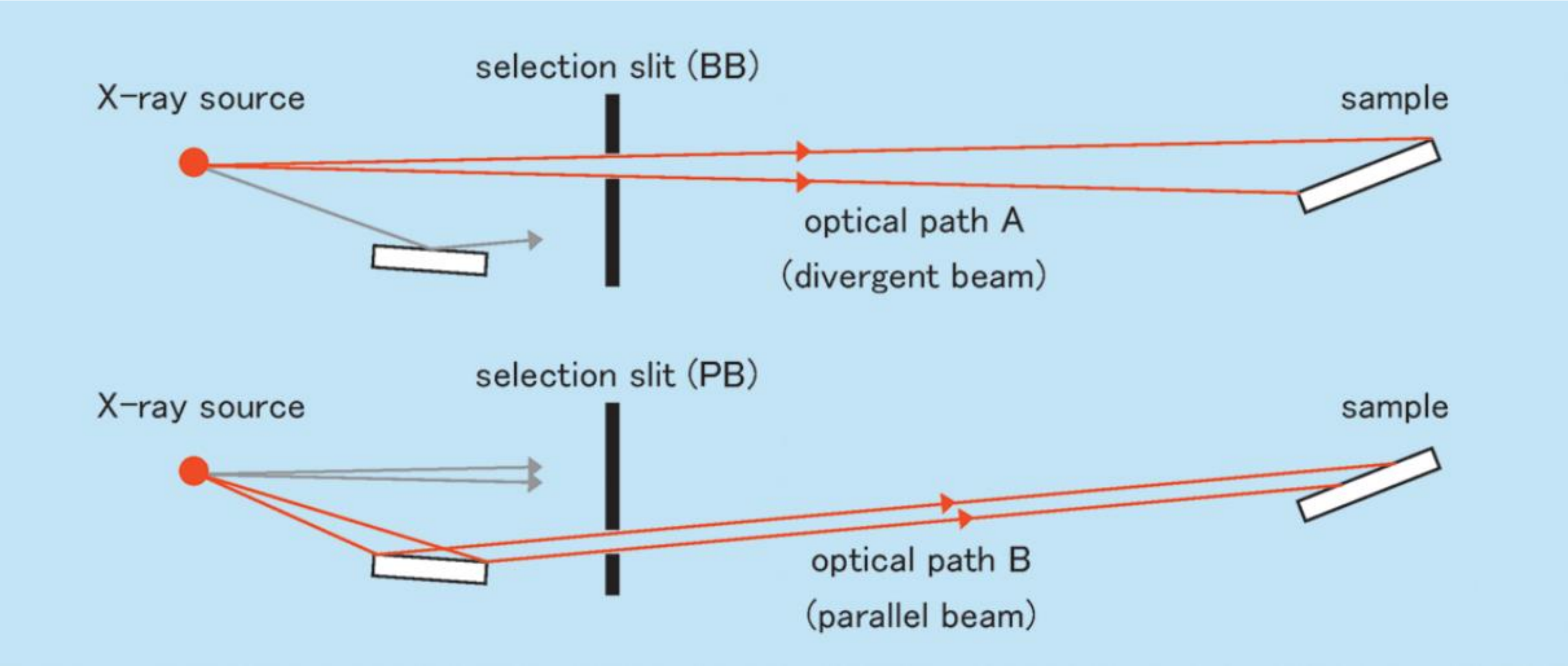


Source

- Standard Copper anode sealed tube source with Tungsten filament.
- Maximum power of 3 kW. Typically run at 1.76 kW (44 kV, 40 mA) to maximize life of anode.
- Primary beam is 0.4 mm (vertical) x 12 mm (horizontal)

Bragg-Brentano (BB) vs. Parallel Beam (PB) selection slits

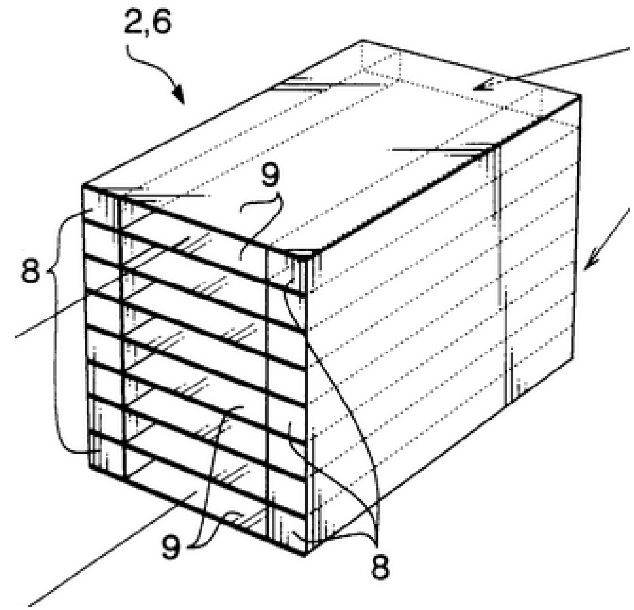
- BB simply allows the beam to diverge
- PB uses a multilayer mirror to produce a (vertically) parallel beam. Still some slight divergence (~0.01°)
- Usually about 5° divergence horizontally (determined by soller slits)



Soller and Length Limiting Slits

- Soller slits are boxes with many metal sheets parallel to plane of diffraction. They limit *horizontal* beam divergence (typically 5°) and the resulting low-θ contribution to peaks.

- Length-limiting slits simply reduce horizontal footprint of beam on sample. Rule of thumb: double length of slit to get approx. beam width at sample (with 5° divergence).



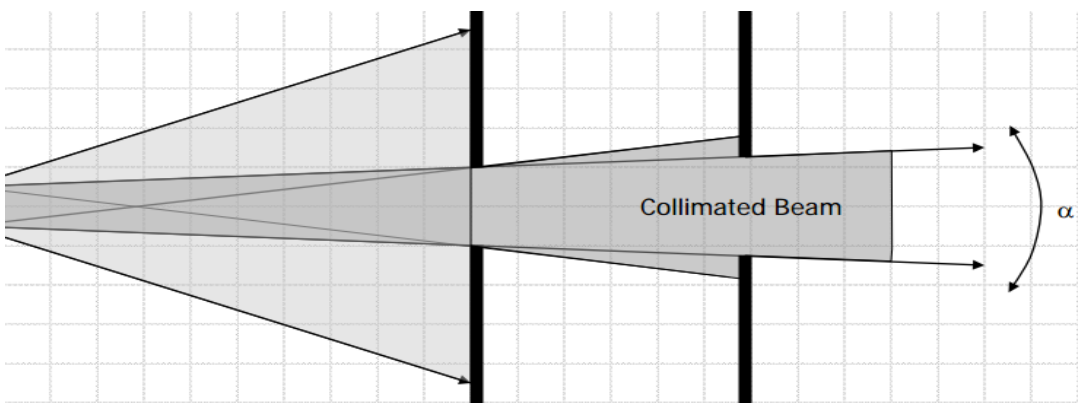
http://www.google.com/patents/EP0999555A1?cl=en

“PSA” and “PSC”

- = parallel slit analyzer (PSA) and parallel slit collimator (PSC). C=incident side, A=receiving.
- Same construction as a soller slit, but foils are oriented *perpendicular* to plane of diffraction.
- In contrast to soller slits, these actually determine resolution of measurement. (Two options are 0.5° and 0.114°)
- Finite width of foils reduces intensity.

Receiving and Incident Slits

- One incident slit and two receiving slits are computer controlled.
- The two receiving slits should be as narrow as possible (0.03 mm min) to achieve maximum resolution.
- Very large reduction in intensity requires long counting times if looking at Bragg reflections.
- Narrow slits ideal if measuring reflectivity or total external reflection.
- In contrast to using PSA to limit resolution, slits can introduce a peak shift if sample height is inaccurately determined.



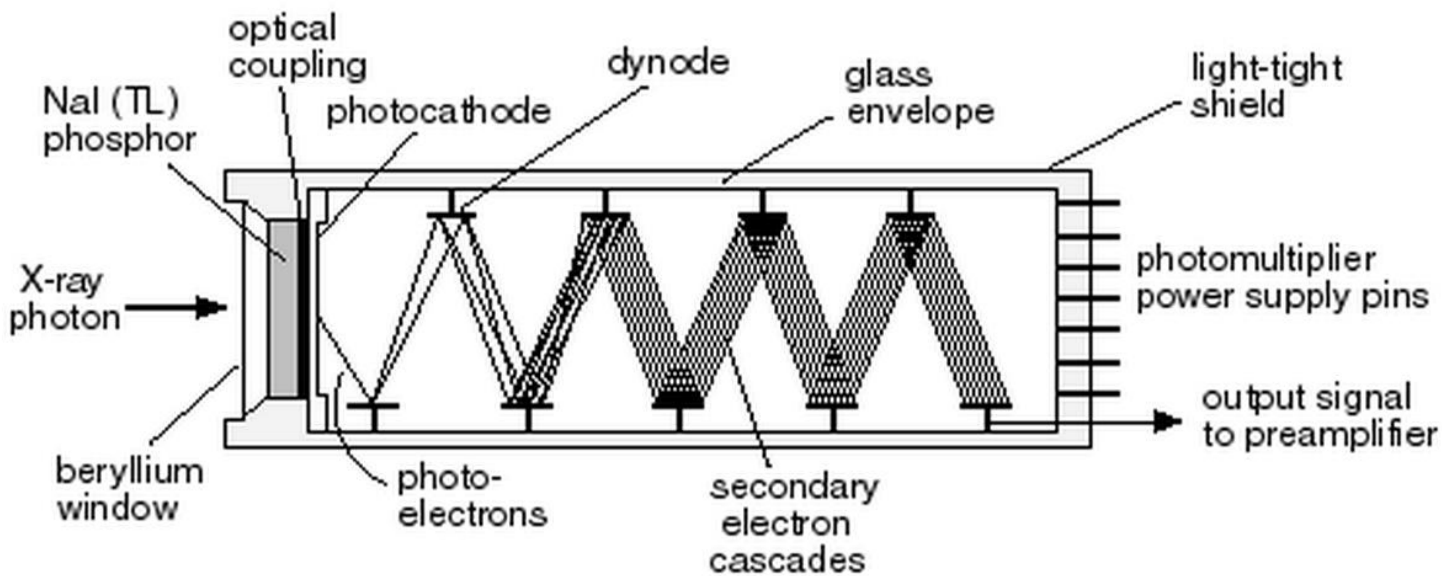
http://www.stanford.edu/group/glam/xlab/MatSci162_172/LectureNotes/06_Geometry,%20Detectors.pdf

Monochromators/Filters

- A Ge monochromator (220 orientation, 2 bounce) is optional on incident beam side. This selects out only Kα1 radiation but at the expense of intensity. Typically just used for single crystals/thin films.
- Graphite monochromator optional on receiving side. Will eliminate Kβ but not Kα2 radiation.
- Kβ filter is a simple Nickel plate on receiving side. Nickel has a band edge between Kα and Kβ energies. Reduces intensity ~ 30%.

Detector

- NaI scintillation point detector.
- Linear to about 500,000 cps. Automatic and manual attenuation options.



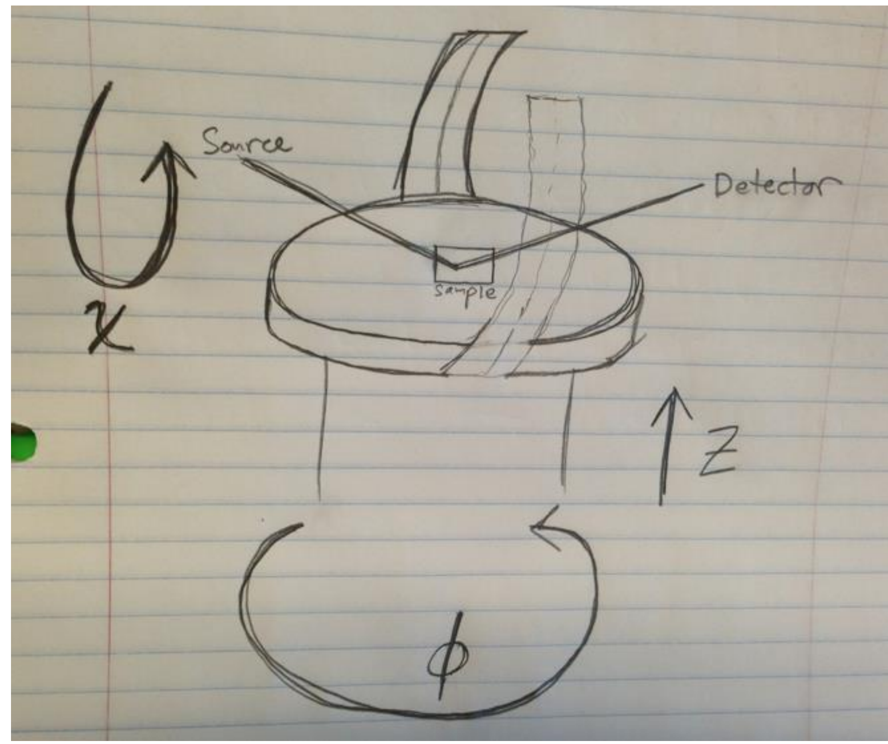
From http://www4.nau.edu/microanalysis/Microprobe/WDS-Scintillation.html

Sample Alignment

- Software has preset and adjustable algorithms for sample alignment.
- Typical alignment: Adjust height (Z) to achieve direct beam half intensity, adjust source/detector axis (ω) to maximize intensity at optimal Z. Finally, adjust Z again when measuring a small-angle reflection (~0.5°) to achieve max intensity.

Sample Stages

- 3 stages available.
- Standard stage: Flat, required to mount a special slit used for aligning optics. Also adequate for basic powder diffraction.
- Euler Cradle: Allows adjustment of χ and ϕ →
- Anton Paar: LN2 temperature control from ~85K to 450° C. No adjustment of χ and ϕ



(Courtesy JIMgraphics)